BEARS Oxygen-14 Beam

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In 2001, the first beam of radioactive Oxygen-14 was successfully accelerated by the 88-Inch Cyclotron. The short-lived isotope ($t_{1/2}$=70 sec) was produced by the small medical cyclotron of the Biomedical Isotope Facility and rapidly chemically processed and transported between the accelerators by the automated systems known as BEARS [1,2]. The initial beam was about 10^5 ions/per sec, although further development, using beam diagnostics developed at ORNL [3], should allow us to reach the design target of ten times that intensity.

The Oxygen-14 beam will be used for experiments investigating highly unstable nuclei, as well as for an important astrophysical measurement for the understanding of novae and other stellar explosions, the reaction $^{14}O(\alpha,p)^{17}F$.

As detailed in last year's annual report, Oxygen-14 is produced in the form of water vapor, then chemically processed, first to carbon monoxide by reaction over white-hot carbon granules, then oxidized to carbon dioxide over a platinum catalyst (see Fig. 1). It was found useful to first separate the water vapor from the remaining target gases, which include contaminants such as ammonia, by temporarily freezing the water in a small coil. This additional step increased the complexity of the process, but it allowed for a clean sample of $H_2{}^{14}O$ in a controlled flow of Helium that was better for the later chemical steps. The separation also makes future development of an Oxygen-15 beam possible, by recycling the expensive Nitrogen-15 that would be used as a target gas. This technology is being considered for adoption for this very use at the ISAC radioactive beam facility at TRIUMF in Vancouver, Canada [4]. The intense ^{15}O beam would be used to measure another important astrophysical reaction, $^{15}O(\alpha,\gamma)^{19}Ne$.

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1. see past annual report submissions on BEARS.
2. J. Powell et al., Nucl. Inst. Meth. A 455 (2000) 452.
3. D. Shapira et al, Nucl. Inst. Meth. A 454 (2000) 409.
4. T. Ruth, private communication.

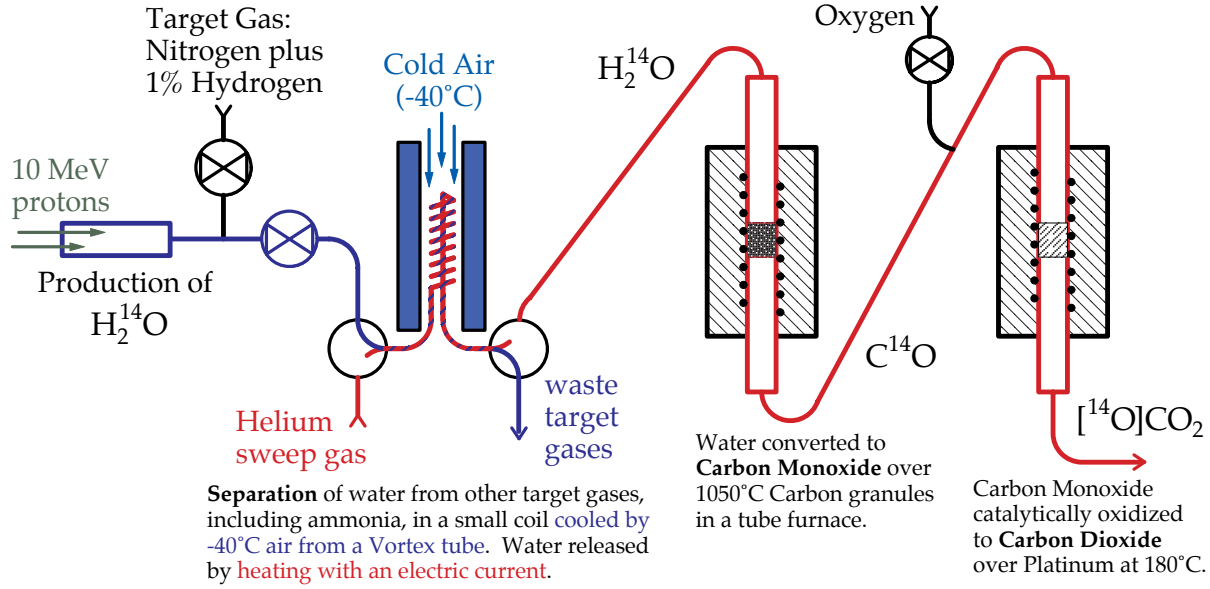

Figure 1: System for production of Oxygen-14 water and conversion to ^{14}O carbon dioxide. Entire process is automated and takes about 10 seconds.